

## LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

## "Gas-Burners, Old and New"

PERMIT me to point out a very obvious clerical error in the notice, in last week's NATURE (p. 270) of my little work having the above title, and to make a few remarks concerning your criticisms on the book. In the sentence, "'Owen Merriman' has taken pains to insist on the two great desiderata of gas-burners—high temperature and low temperature," the latter word is doubtless intended for *pressure*; and the sentence should read "high temperature and low pressure." It would have been scarcely necessary to make this correction, but that the notice may perhaps be read by many who are incapable of suggesting the correct reading, and to whom therefore the sentence as it stands will be absolutely meaningless.

While fully appreciating the kindly nature and intent of your criticisms, I cannot pass by, without a word of defence, your statement that you think I have "gone too far in attempting to give a popular theory of luminous combustion." I hope to be able to show that the particular extracts from that portion of the book to which exception is taken are practically correct, and, so far as could be looked for in a work addressed to miscellaneous readers, sufficiently precise. To this end I will deal with the various extracts *seriatim*. That "the various gases which constitute ordinary coal-gas do not all burn together in the flame" is a matter I had thought to be established beyond reach of dispute. But if evidence is required of the truth of the assertion, I need only point to a table prepared by Prof. Landolt, showing the composition of gases in the different parts of a gas flame, which is given by Prof. T. E. Thorpe, F.R.S., in a lecture on "Flame," forming one of the Manchester series of Science Lectures (Manchester: John Heywood). By this table it is clearly shown that in a gas flame,  $3\frac{1}{2}$  inches high, the olefines, or heavy hydrocarbons, do not diminish in amount until a height of 1.58 inches is reached; while the proportion of hydrogen is considerably diminished at a height only of 0.39 inch. Although it may not be mathematically correct to say that "the amount of light developed by any coal-gas flame is directly proportional to the degree of intensity to which the temperature of the carbon particles is raised," seeing that the light emitted is not in *exact* proportion to the temperature of heat, the statement is sufficiently correct for a popular treatise. What was chiefly intended to be enforced was that the amount of light evolved from a gas flame increases with its temperature, and in such a work a mathematical degree of exactitude is hardly looked for. Now, with regard to the other matters which are raised. To account for the destruction of luminosity which occurs when air is introduced into a gas flame, two theories have been put forward. According to the first, the heavy hydrocarbons at once meet with sufficient oxygen and are immediately consumed, without their carbon being first raised to a white-hot state; but this theory alone will scarcely explain the phenomenon, seeing that the effect of pure oxygen is to increase the luminosity of a flame. The other and more rational theory—and the one which is more generally accepted—supposes that the inert nitrogen which is thereby introduced reduces the heat-intensity of the flame "below the temperature required to decompose the hydrocarbons." It may be that to some extent both causes are at work. Lastly, as to the relative temperatures of a luminous and a non-luminous flame. Although the *average* temperature of the latter is higher than the former—as indeed it must be, seeing that the same *quantity* of heat is contained in a less space, the non-luminous flame nowhere develops so high a temperature as is found at certain of the hottest portions of the luminous flame. Mr. R. H. Patterson, in an article on the action of the blowpipe considered with reference to the principles of gas illumination (*Journal of Gas Lighting, &c.*, vol. xxxv. p. 831), states that in the luminous region of an ordinary gas flame he has succeeded in melting a platinum wire: a result which he could never attain with a non-luminous flame."

July 21

"OWEN MERRIMAN"

[We thank our correspondent for pointing out the clerical

error "low temperature" for "low pressure" in our article. We consider that the sentence, "The various simple gases which constitute ordinary coal do not all burn together in the flame; the temperature required to effect their ignition being lower for some of them than for others," is misleading. The ordinary reader would understand this to mean that the constituent having the lowest ignition point catches fire and burns away first, and then the constituent of next lowest ignition point catches fire and burns away, and so on; whereas Blochmann's researches show that the combustions are not distinct, but that the rate of combustion of the hydrogen is greater than the rate of combustion of the other inflammable gases.

We do not think it "sufficiently correct" to say that the intensity of light is *directly proportional* to the temperature of the coal-gas flame: perhaps it would be nearer the mark to say that the intensity of the light varies as the fifth power of the temperature within certain limits. The admission of air into the Bunsen flame destroys the luminosity more by *dilution* and *oxidation* than by *refrigeration*.—ED.]

## The "Cotton-Spinner"

IN a note on this rare British Holothurian (published in NATURE on June 12, p. 146), I drew a distinction between the kind of observations that were possible to a student in a museum and to one who was working at a laboratory specially adapted for biological investigation and situated on the sea-shore.

The experiences of the last few days have shown me only too well that this distinction was not overdrawn or too refined. By the kindness of Mr. John Snell of Truro, I have been favoured with two consignments of the "Cotton-Spinner;" three specimens which reached me on Monday by parcels post gave very sufficient evidence of having died some hours before. This mishap induced me to propose to Mr. Snell that he should send me specimens by express, and entrust them to the charge of the guard of the train; for this suggestion I am indebted to Dr. Günther. Mr. Snell not only did this to-day, but he was good enough also to warn me by telegram that the specimens would reach Paddington at 8 p.m. this evening. I was at the station to meet them, and I have no doubt that the comparatively fresh condition of the sea water was due to the attention of the guard of the train. Notwithstanding all this care and trouble, the three "Cotton-Spinners" were dead.

I have given this detailed, and, I fear, tedious exposition of the whole case, because it seems to me to clench the argument that the problems of the physiology of marine forms, and especially of those less-known creatures which live at a depth of—like the "Cotton-Spinner"—ten to twenty fathoms, are not soluble at some distance from the coast, however great be the trouble or the care that is taken in forwarding them. We must have a laboratory on the sea-shore.

The only fact that I have been able to observe is that the threads of the "Cotton-Spinner" do undoubtedly attach themselves to objects in their vicinity: one of the specimens obtained this evening was attached to sea-weed; from the cloacal orifice a connected strand of threads, about one-fifth of an inch in width and an inch in length, spread out at its free end into a number of more free threads which had attached themselves to the seaweed which had been placed in the water; they extended over about two inches in breadth. From what I have learnt of the extensile and swelling power of these threads, I should take it that about as much had been expelled as would occupy the greater part of the cloacal cavity. A woodcut illustrating the cloacal cavity so filled by tubes, and drawn from a spirit specimen preserved in the British Museum, will be given in my paper on this animal, which will be published in the next (October) part of the *Proceedings* of the Zoological Society.

August 1

F. JEFFERY BELL

## Krakatoa

I MOST respectfully beg to point out to you a few errors made in the English version of my "Short Report on the Krakatoa Eruption," published in NATURE, May 1.

It says on p. 15:—"In this eruption very curious objects were ejected, *i.e.* very smooth, round balls, resembling marbles, to the size of  $1\frac{1}{2}$  to 6 centimetres in diameter. They are full of acids; they contain 55 per cent. carbonate of lime," &c.

The words italicised are wrong. The original says: *Zij Cruisen sterk met Zuren*, which means "they strongly effervesce when

*moistened by powerful acids.* P. 11, column 1, line 34, "1860" should be "1680"; p. 12, column 2, line 28, and also p. 13, column 1, line 5, *steatite* should be *pitchstone* (a vitreous variation of pyroxene andesite).

R. D. M. VERBECK,

Director of Java Geological Survey

Buitenzorg, Java, June 19

### THE METEOROLOGY OF BEN NEVIS

AS regards changes of weather and many other problems of meteorology, a knowledge of the vertical variations which take place in the atmospherical conditions is of first importance; and the only way we can hope to arrive at this knowledge is by regular observations made at stations as near each other as possible in horizontal direction, but differing as much as possible in height. This point was very clearly seen many years ago by the late Mr. Allan Broun, and the idea was practically worked out by him in the elaborate series of meteorological and magnetical observations simultaneously made on the peaks and ridges and in the adjoining valleys of the Western Ghats. These observations are the best anywhere yet made to supply the observational data for the discussion of some of the more important problems of meteorology; and the science sustained no ordinary loss in the death of Mr. Broun before he had discussed the observations which had been collected by his genius, energy, and self-denial.

Next in scientific value to Mr. Broun's observations are those made on Ben Nevis since June 1881. The special advantages of Ben Nevis as a meteorological observatory are that it rises to a height of 4406 feet, and is little more than four miles distant from the sea at Fort William, and that it is situated in the track of the great storms which sweep over North-Western Europe from the Atlantic. Hence observations made on the top and at the base of Ben Nevis possess a value altogether unique in meteorology; particularly in discussing the atmospheric movements which accompany cyclones and anticyclones, and in investigating tornadoes and other destructive winds which originate when the air is abnormally warm and moist near the surface, while aloft the temperature and humidity diminish with abnormal rapidity.

For the preliminary inquiry which is necessary in order to determine the chief points in the meteorology of Ben Nevis, there are now available for a comparison of the climate of the top of the mountain with that of the sea-level at Fort William, simultaneous observations for twenty-two months, viz.: from June to October of the years 1881 and 1882, and from June 1883 to June 1884. As regards the temperature, the monthly means for Fort William were compared with the normal monthly temperatures of that place as given in the paper on the "Climate of the British Islands" (*Journ. Scott. Met. Soc.*, vol. vi. p. 33). From the differences thus obtained, the approximate normal temperatures at Ben Nevis Observatory were determined. The coldest month is February, the mean being 22°0, and the warmest, July, 41°3, August being nearly as warm, the mean being 41°1; and the annual mean temperature 30°9. Comparing the normals with those of Fort William, the greatest difference is 18°0 in May, from which it steadily diminishes to 14°9 in December, and then rises more rapidly to the maximum in May; the annual difference is 16°3. The greatest difference, or the most rapid fall of temperature with height, is in the spring and early summer, when the climate of the west is driest, the temperature of the Atlantic lowest relatively to that of the air, and the top of the mountain still covered with snow. The least difference is in late autumn and early winter, when the climate of the west is wettest, Ben Nevis most frequently and densely clouded, and the temperature of the Atlantic highest relatively to that of the air. The observations of temperature at the high- and low-level stations show a variation with the hour of the day even

more decidedly marked than that with season. Thus, in January the decrease of temperature, deduced from the mean maxima and minima respectively were 16°2 and 15°2, but in April these were 23°1 and 12°9, being thus in January nearly equal, whereas in April the difference of the maxima was nearly double that of the minima.

The annual means give, therefore, a decrease of temperature with height at the rate of 1° for every 270 feet of ascent—the most rapid decrease being 1° for every 245 feet in April, and the least rapid 296 feet in December.

But the individual observations show wide divergences from these rates of decrease. As disturbing conditions, the more important of these are the instances of abnormally large decrease, seeing that these imply a temperature near the surface much above the normal with respect to the higher strata, by which the equilibrium of the atmosphere is destroyed, and rapidly ascending and descending currents are generated, thus giving rise to some of the most destructive storms of wind. Of the illustrations the observations give of a rapid decrease, reference may be made to those of October 13, the day preceding the great storm which proved so destructive to the fishermen on the Berwickshire coast.

Even more striking, and, as regards their bearing on the theory of storms and weather changes, perhaps even more important, are those instances of abnormally small differences between the temperature at the top and base of the mountain, of which a good example which occurred on September 21, 1882, was given in NATURE, vol. xxvii. p. 176. All such cases have been accompanied with a high temperature and an excessive dryness of the air. It is these qualities of air which immediately connect the phenomena with the great cyclonic and anticyclonic systems in which or near to which Ben Nevis is for the time situated. The most striking case of all occurred on December 31, 1883, on which day the maximum temperature at Fort William was 30°6, and minimum 27°2, these being at Ben Nevis Observatory 32°0 and 22°8. At 11 a.m. the temperature at Fort William was 27°5, but on Ben Nevis it was 32°0, with a wet bulb as low as 24°4. Hence at this hour the temperature of the air was 4°5 higher at the Ben Nevis Observatory than at Fort William, 4406 feet lower down, and this relatively high temperature was accompanied with excessive dryness represented by the humidity of 33. From 6 a.m. to noon temperature was continuously higher on Ben Nevis than at Fort William. At 11 a.m. the abnormality in the vertical distribution of the temperature amounted to 20°5. It is of importance to note that at this time of relatively high temperature and great drought, atmospheric pressure was very high at the Observatory, the reading of the barometer at 32° being 25·915 inches, being absolutely the highest that has occurred from November 28, 1883, to June 30, 1884. At Fort William the sea-level pressure was 30·608 inches.

Another peculiarity of the temperature is the small diurnal variation caused by the sun at all seasons, but particularly in winter; and the large variation due to the temperature changes which accompany the passage of cyclones and anticyclones over the Observatory. The means of the hourly observations show that even in May the difference between the mean warmest and mean coldest hour was only 3°3. In January the difference was only 0°8, and in this month the highest hourly mean occurred during the night, and the lowest during the day. On the other hand, the difference of the mean daily maxima and minima for January was 6°7. In truth, the influence of the sun on the temperature of the air is all but eliminated during the winter months owing to the thick covering of mist, fog, and cloud, in which the mountain is almost constantly wrapped.

Since June 1881 the highest temperature on Ben Nevis was 59°3 on August 8, 1882, and the lowest 9°9, on Feb-